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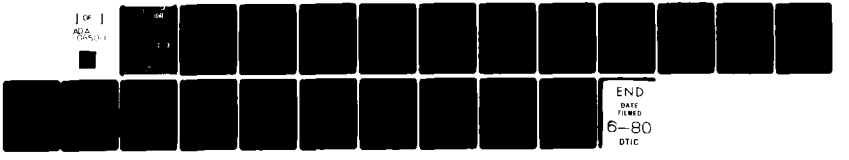

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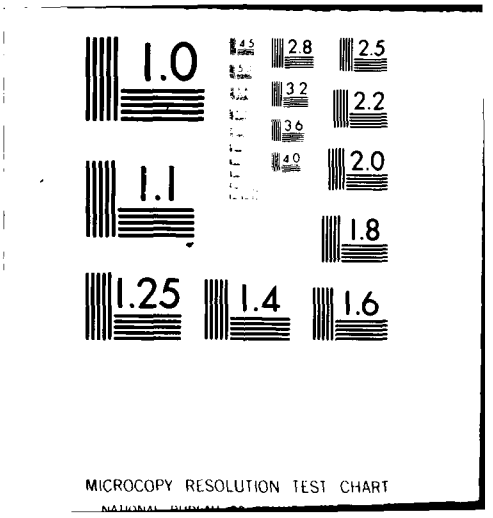
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ROYAL NAVAL PERSONNEL RESEARCH COMMITTEE
(RNPRC)

MEMBERSHIP - December, 1978

Chairman	Professor K W Donald DSC QP MA MD DSc FRCP FRSE
Medical Director General (Naval)	Surgeon Vice-Admiral Sir John Rawlins KBE QHP FRCP FFCM FRAeS
- The Medical Officer-in-Charge Institute of Naval Medicine	Surgeon Rear-Admiral J A B Harrison QHP MRCS LRCP FRCR DMRD
- Director of Health and Research (Naval)	Surgeon Captain P F Toal MB BCh MFCM DPH DIH
Chief Scientist (Royal Navy)	Mr C C Fielding MA
- Deputy Chief Scientist (Navy)	Mr P R Wallis
- Senior Psychologist (Naval)	Mr E Elliott BSc FBPsS
Director of Naval Warfare	Captain D G Armytage
Flag Officer Submarines	Rear-Admiral R R Squires
Dr A D Baddeley MA PhD	MRC Applied Psychology Unit
Professor W Burns CBE MB ChB DSc FRCP	Emeritus Professor of Physiology, University of London
Professor G R Hervey MA MB	Professor of Physiology, University of Leeds
Professor R J Linden MB ChB PhD DSc FRCP	Professor of Cardiovascular Studies, University of Leeds
Secretary	Dr H W Bunje MD FRCP MRC Headquarters Office Staff
Assistant Secretary	Mr J A Brown MM MRC Headquarters Office Staff

CONTENTS

INTRODUCTION

Changes in RNPRC Membership

1.	Surgeon Vice-Admiral Sir John Rawlins	vice	Surgeon Vice-Admiral Sir James Watt (MDG(N))
	Surgeon Rear-Admiral J A B Harrison	vice	Surgeon Rear-Admiral J S P Rawlins(INM)
	Surgeon Captain P F Toal	vice	Surgeon Captain R J W Lambert (DHR(N))
	Mr C C Fielding	vice	Mr B W Lythall (CS(RN))
	Mr P R Wallis	vice	Dr J Tunstead (DCS(N))
	Rear-Admiral R R Squires	vice	Rear-Admiral J D E Fieldhouse (FOSM)
	Captain D G Armytage	vice	Captain D R Reffell (DNW)

2. The previous report recorded that Dr A D Baddeley had consented to take over Chairmanship of the Operational Efficiency Subcommittee. In the event, however, it was decided, after consultation with Chief Scientist (Royal Navy) and the Senior Psychologist (Naval), to wind up the Operational Efficiency Subcommittee as then constituted and to establish in its place a new Psychology Subcommittee, with a broader academic base, and Dr Baddeley assumed Chairmanship of the new Subcommittee.

3. In the early part of 1978, Professor O G Edholm indicated his wish to resign the Chairmanship of the Environment Subcommittee and to withdraw from further participation in the work of the RNPRC. Professor Edholm had been associated with the work of the RNPRC for many years and the Committee noted with great regret that his services would now be lost to the Committee. Enquiries to seek a new Chairman for the Environment Subcommittee are continuing.

4. Difficulties facing the setting up of a tri-Service body to deal with problems of Physical Fitness have led to agreement by the Committee, at the request of the Royal Navy, to the setting up of a Subcommittee on Physical Fitness. Professor R J Linden has consented to chair the new Subcommittee and arrangements have been made for the inaugural meeting to be held in the early part of 1979.

Current Work

5. The work of the Committee is summarised below in individual reports by the Chairmen of the various Subcommittees and working groups. These sub-groups provide a forum for discussion of the various projects, of the conduct of experimental work and of the final results. Recommendations in the light of the work are prepared by sub-groups and, if endorsed by the RNPRC, communicated to the appropriate Service department.

6. The arrangements for carrying out studies are agreed by the Subcommittee in discussion with the staff of those mainly concerned, principally the Medical Director-General (Naval) and Chief Scientist (Royal Navy). In broad terms the work is carried out in the following ways:

(a) by Navy Department scientists and medical officers carrying out research within the Service with advice, when needed, from the RNPRC on the scientific aspects of the work;

(b) in Navy Department establishments with assistance from the Medical Research Council (MRC) in terms of equipment and scientific or technical personnel;

(c) by MRC staff working on projects in MRC laboratories.

Reports

7. Reports covering the work are produced as MRC/RNPRC documents and distributed widely within the Ministry of Defence and also on an international basis in consultation with the Defence Research Information Centre. It has proved possible in almost every case to produce reports which are of 'unlimited' distribution and therefore freely available to whoever may need them. Scientists associated with the RNPRC, both inside and outside the Royal Navy, are encouraged to publish their findings in the open scientific press, subject to the customary MOD clearance.

8. With the increase of in-Service research, a number of establishments such as INM, AMTE(PL) and AMTE(APU) produce their own reports. Such reports are independent of, and do not contain reference to, RNPRC or MRC.

THE ROLE OF THE RNPRC

Terms of reference

9. The terms of reference of the RNPRC are:

(a) to advice the MRC on such investigations as the Council may be asked to undertake on biological, medical, physiological and psychological problems affecting the health and fighting efficiency of Naval personnel and to suggest investigations with a view to increasing or improving the health, fighting fitness and environment of Naval personnel, and to aid and supervise such investigations as expedient.

(b) to advise the Navy Department through or on behalf of the MRC on the Navy Department Personnel Research Programme, including biological, medical, physiological and psychological aspects affecting the health and efficiency of Naval personnel.

RNPRC/MOD liaison

10. The arrangements recorded in the last report have continued in operation and have continued, also, to work well. Representatives of the RNPRC now attend meetings of the Chief Scientist's Advisory Committee on Human Engineering Research and Chairmen of the Subcommittees have an opportunity of meeting with Navy Department staffs annually for discussion of the overall in-Service programme of personnel research. Discussions have been initiated between RNPRC and AMTE(PE) to concert improved liaison and co-operation in the field of physiological research.

SUMMARY OF WORK

ENVIRONMENT SUBCOMMITTEE (ES) - Chairman: Professor O G Edholm (up to January, 1978)

Protective Clothing

11. Following the experimental work reported upon in the last report, some improved clothing assemblies were tested in cold chamber conditions and, as a result, the Subcommittee has been able to recommend the adoption of clothing assemblies, from amongst items already available in the Services, which provide improved protection for men in exposed positions on HM Ships. The need for improved protection of hands, face and feet remains an outstanding requirement and this matter is being kept under review.

HEARING SUBCOMMITTEE (HeS) - Chairman: Professor W Burns

12. There has been little activity on the part of the Hearing Subcommittee during the period under review but a number of on-going surveys, being carried out under the aegis of the Subcommittee, are continuing. These include a survey of deafness in divers, a study of noise levels in ships and an audiometric survey of engineering staff. These are long term investigations and it must be some time before sufficient results are available for assessment by the Subcommittee.

PSYCHOLOGY SUBCOMMITTEE (PS) - Chairman: Dr A D Baddeley

13. The Psychology Subcommittee was set up to continue the work of the former Operational Efficiency Subcommittee following the retirement of Professor Drew from the Chairmanship of that body but, as the moment seemed opportune, it was deemed expedient to review the composition and functions of the Subcommittee. In the event it was decided to widen the academic representation on the Subcommittee and to re-define the terms of reference as follows:

(a) to advise on the application of psychological research to the solution of naval problems;

(b) to set up working parties to investigate specific problems as required;

(c) to monitor, as necessary, extra-mural research on naval problems.

14. The Subcommittee held its first meeting in April, 1978, and has since met on two further occasions during which it has devoted its first efforts to obtaining a general understanding of naval problems. During these meetings, visits have been undertaken to a naval vessel and to a number of shore-based training and research establishments.

15. As an outstanding item of business remaining from the Operational Efficiency Subcommittee, the Psychology Subcommittee reviewed a paper prepared by the late Dr A Carpenter on 'Speech Communication' for incorporation in the handbook 'Human Factors for Designers of Naval Equipment'. The paper was approved for publication.

SUBMARINE SUBCOMMITTEE (SMS) - Chairman: Professor R J Linden

16. The Submarine Subcommittee has been currently concerned with two particular problems, ie the effects of carbon dioxide and the effects of carbon monoxide.

(a) CO_2 investigations

In the early part of 1977 the Submarine Subcommittee convened an ad hoc group to consider a preliminary report on the work carried out up to that time and was able to advise on the pursuit of further investigations. Reports on this work were received at the end of 1978 and have not yet been fully studied. However, preliminary study would seem to indicate that levels of 0.5%,or even 1.0%,CO_2 would be acceptable. It proved possible in the later studies to show that urine acid-base changes seen in a previous study were probably artefactual due to imperfect urine collection methodology. This could not have been forecast. In addition, all changes proved to be reversible on return to fresh air. It has been established, also, that variation of Vitamin D levels in the presence of these concentrations of CO_2 does not affect levels of mineral excretion.

(b) CO investigations

Reports on this investigation were also received at the end of 1978 and, again, have yet to be subjected to detailed study. The CO level in submariners is commonly found to be about 15ppm, rising in the case of some smokers to 50ppm and at these levels there are indications of some ECG changes (Arrhythmic); postulated as being changes caused by a specific toxic effect of CO on atrial pacemaking or conducting tissues. These problems are being considered further. It was not possible to detect changes in mental performance due to increased CO levels but comment was made that one test, the LOGIT test, was probably insufficiently sensitive to be an indication of CO effects.

17. Arrangements are being made for detailed study of the reports touching on the foregoing matters by a meeting of the full Submarine Subcommittee with a view to determining what further investigations may be needed.

SURVIVAL-AT-SEA SUBCOMMITTEE (SS) - Chairman: Professor G R Hervey

18. There has been no meeting of the Survival-at-Sea Subcommittee during the period under review. There has, however, been continuing work on problems of immersion hypothermia and the report on Surgeon Commander Golden's work (now nearing completion as a PhD thesis) at the University of Leeds is currently awaited by the Subcommittee. The Department of Survival Medicine, with Surgeon Commander Golden as Medical Officer in Charge, has been established at the Institute of Naval Medicine, and promises to form a point of forum for action in survival problems.

UNDERWATER PHYSIOLOGY SUBCOMMITTEE (UPS) - Chairman: Professor K W Donald

19. As in the past, the role of the UPS has been that of an advisory body covering the RN programmes in the Deep Diving and Submarine Escape fields. The experimental and laboratory work involved is carried out at the AMTE(Physiological Laboratory), the

Admiralty Experimental Diving Unit and HMS VERNON.

Work by AMTE (Physiological Laboratory)

20. During the period under review, the UPS has considered a number of reports prepared on the basis of work carried out at the Physiological Laboratory. These include:

(a) Some cardio pulmonary responses to exercise in an increased ambient pressure of oxy-helium - RNPL Report No 8/75

In these chamber experiments it was shown that divers were able to perform heavy work at 240m (800 ft). However certain findings suggested the possibility of decreased lung compliance and that, under such conditions, the tension of helium may facilitate the pulmonary irritant effect (Lorrain Smith) of oxygen. These effects, whatever their cause, appeared completely reversible but, nevertheless, they were being further investigated.

(b) A Method of measuring oxygen consumption and minute ventilation in semi-closed circuit underwater breathing apparatus - RNPL Report No 3/77

The technique described allows both the oxygen uptake and ventilation to be measured. The subject was in a tank of water with shoulders and head above water. A bicycle ergometer was used. Results were compared with direct expired gas collected at 1 Atm. Results appeared most promising and will allow oxygen uptake and ventilation to be measured under operational conditions.

(c) Pneumatically controlled mixed gas underwater breathing apparatus - RNPL Report No 5/77

The laboratory has produced a re-breathing semi-closed apparatus in which the gas mixture supplied contains a constant amount (mass) of oxygen no matter what the depth.

The critical breakthrough here is a laminar flow element across which the pressure gradient (which is directly proportional to the mass of oxygen flowing through it) is kept constant by a feed-back regulating mechanism.

Such a development has been required in mixture diving for some forty years, if not longer. The device has been patented.

(d) Observations on men at pressures up to 300 msw (31 bar) - AMTE(E) Report No 78401

The Subcommittee also received and discussed a report on 'Observations on men at pressures up to 300 msw (31 bar)'. This was in the nature of an introductory report on work in this area and the Subcommittee expect to receive more detailed reports on different aspects of the work in due course. One particularly interesting new finding after these saturation dives was a typical 'ball race' (cog-wheel) appearance of some red cells which decreased in number and disappeared some days after. Investigations are proceeding as to whether this change (if validated) is an indication of marginal D.C.S. or unsatisfactory decompression.

21. The Chairman of the Subcommittee has now been appointed Chairman of the Biomedial Working Party of the Standing Committee on Submarine Escape and Rescue. He also represents the RNPRC on the Ethical Committee of the Ministry of Defence (Personnel

research). A most useful new exercise has been the Chairman's attendance at the Review Meetings of the AMTE Engineering and Human Factors Department.

22. At its last meeting it was generally agreed that the UPS should recruit more academic members. Professor Walder (Newcastle) and Professor Norman (Aberdeen) have already joined the UPS and discussions with CS(RN), Mr Tupper (AMTE) and Dr Hempleman as to the remit and functioning of UPS are about to take place.

PHYSICAL FITNESS SUBCOMMITTEE (PFS) - Chairman: Professor R J Linden

23. Following the closing down of the former Physical Fitness Working Party, and the subsequent retirement of Professor O G Edholm, the Royal Navy requested the RNPRC to set up a new Subcommittee to act as a source of advice on problems relating to physical fitness in the Navy and, particularly, relating to physical fitness for performance of specific tasks. The RNPRC has agreed to set up a new Subcommittee for this purpose and Professor Linden has consented to chair the Subcommittee. Arrangements are in hand for an inaugural meeting of the Subcommittee to be held early in 1979.

SHIP MOTION WORKING PARTY (SMWP) - Chairman: Professor G R Hervey

24. The first meeting of the Ship Motion Working Party was held early in 1977 and, altogether, the Working Party has met on six occasions during the period under review. The Working Party's remit divides into two areas:

(a) Motion Sickness

It seems clear that motion sickness, even in a mild form well short of vomiting, is both common and potentially liable to degrade performance, although the extent of this impairment is probably variable and not well investigated. In the special case of the life-raft situation motion sickness - through its effects on morale and behaviour, on fluid balance and on the likelihood of hypothermia - poses a substantial hazard to survival; and a fully practical treatment method is certainly not yet available.

(b) Biomechanical effects of motion

It appears likely that performance of some tasks is degraded by the motion of the ship but, here again, the extent of any impairment does not appear to have been well investigated.

25. In the course of discussions held over the series of meetings referred to above the Working Party has proposed a number of lines of investigation:

(a) A study of the incidence and severity of motion sickness among personnel serving in HM Ships

In collaboration with INM a form of questionnaire has been devised which, it is hoped will yield information on these points. Arrangements are being made for the questionnaire to be distributed among ships of the Fleet and it is hoped, also, to obtain some subjective information regarding task performance variation from supervising officers regarding men under their command. Opportunity was taken to carry out a pilot investigation of this type in two ships and the Working Party received a report on this study (SMWP 9/78) which

indicated clearly the value of the information which may be expected to derive from the full scale study.

(b) Laboratory studies of performance of 'tracking' type tasks

Studies in this area involve the use of a motion simulator capable of producing realistic simulation of ship motion and installations of this type are not currently available in the United Kingdom. Nevertheless, a small pilot study is to be arranged, under the auspices of the Senior Psychologist (Naval), using the motion simulator at the Warren Spring Laboratory, which it is hoped will yield useful results.

Because of the lack of suitable installations in the United Kingdom, the Chairman and Secretary of the Working Party visited the United States in June, 1978, to acquaint themselves at first hand with work being undertaken there on studies relative to ship motion. They were able to visit the US Naval Aerospace Medical Laboratory Detachment at Michoud, where there are large scale installations designed to assist investigations in this field, and to discuss with workers there the studies that are being undertaken. Both here, and in later discussions at the Office of Naval Research in Washington, assurances were received that the US authorities would welcome the secondment of a UK physiologist to participate in the investigations. Facilities would also be given for the conduct of special investigations which might be of interest to the UK authorities. Visits were also made to a number of leading scientific centres where the work was discussed with the scientists concerned.

A report on the visit to the United States (SMWP 7/78) was discussed by the Working Party at its sixth meeting, and the Working Party advocated that enquiries be made to see whether funds can be made available to support the collaborative work of a British physiologist at Michoud. This recommendation is currently being pursued.

(c) Pharmacological studies

The Working Party has strongly recommended the carrying out of a series of pharmacological studies in connection with the prevention and treatment of motion sickness and it has been agreed that a scientist and technician shall be recruited for this work which will be carried out at the Institute of Naval Medicine. The nature of the work to be undertaken is outlined in the paper SMWP 5/78, and action is currently in hand to recruit the staff required.

(d) Habituation studies

The Working Party has recommended that funds be provided to support a study of the feasibility of adapting men to ship motion, having in mind particularly the value of such a process in the case of highly trained key personnel who might otherwise be so incapacitated by motion sickness as to be unable to perform adequately at sea. Proposals have been submitted to the Working Party (SMWP 4/78) for a study of the usefulness, in the naval context, of a relatively simple, non-specific deconditioning procedure which has been used in the RAF by Dr Dobie, who is also a member of the current working party. Enquiries are proceeding on the possible funding of this investigation.

(e) Fundamental physiological studies

The Working Party has noted the possibility that any further substantial advance in understanding of the effects of ship motion may be dependant upon basic investigations, including the area of possible changes in brain stem neural transmitters as the result of motion. It has recommended that the possibilities for such fundamental investigations should be kept under review.

Annex A
to RNP 2/79

MEETINGS of the RNPRC and its sub-groups have been held as follows. Copies of the minutes can be made available to RNPRC members on request.

MAIN Committee		
60th Meeting	October 1977	RNP 4/77
CHAIRMEN's Meeting		
6th Meeting	January 1978	RNP 4/78
7th Meeting	December 1978	RNP 1/79
ENVIRONMENT Subcommittee		
Ad hoc group on Protective Clothing		
4th Meeting	May 1977	ES 4/77
PSYCHOLOGY Subcommittee		
Subcommittee meeting		
1st Meeting	April 1978	PS 6/78
2nd Meeting	September 1978	PS 12/78
3rd Meeting	December 1978	PS 1/79
SUBMARINE Subcommittee		
Ad hoc group on CO_2 exposure		
1st Meeting	May 1977	SMS 1/77
UNDERWATER PHYSIOLOGY Subcommittee		
Subcommittee Meeting		
53rd Meeting	November 1978	UPS 5/78

SHIP MOTION WORKING PARTY

Working Party Meeting

1st Meeting	January 1977	SMWP 3/77
2nd Meeting	May 1977	SMWP 6/77
3rd Meeting	August 1977	SMWP 12/77
4th Meeting	November 1977	SMWP 20/77
5th Meeting	March 1978	SMWP 6/78
6th Meeting	October 1978	SMWP 10/78

Annex B
to RNP 2/79

REPORTS AND PAPERS

GENERAL

Committee Papers

RNP 1/77	Report for the period January 1975 - December 1976.
RNP 3/77	Working Party on hyperbaric systems for diving R & D.
RNP 3/78	RNPRC relations with MOD.

ENVIRONMENT Subcommittee

Committee Papers

ES 2/77	Headaches associated with cold-exposure.
ES 3/77	Cold and foul weather clothing assemblies for RN personnel (INM Report 11/77)

PSYCHOLOGY Subcommittee

Committee Papers

OES 20/74	Colours for sizes.
PS 2/78	Continuous intense noise masks auditory feedback and inner speech.
PS 3/78	Evaluation of auditory, visual and dual-mode displays for prolonged sonar monitoring in repeated sessions.
PS 4/78	A reappraisal of artificial signals as an aid to a visual monitoring task.
PS 5/78	Human Factors - Speech Communication.

SUBMARINE Subcommittee

Committee Papers

SMS 1/77	Effects on man of continuous exposure to 0.5% CO_2 (INM Report 22/77).

UNDERWATER PHYSIOLOGY Subcommittee

Committee Papers

RNPL Report 8/75	Some cardio-pulmonary responses to exercise in an increased ambient pressure of oxy-helium.
RNPL Report 9/75	A comparative analysis of the effects of gases of differing molecular weights and ambient pressures, but the same comparative gas density, upon some physiological parameters.
RNPL Report 3/77	A method of measuring oxygen consumption and minute ventilation in semi-closed circuit underwater breathing apparatus.
RNPL Report 5/77	Pneumatically controlled mixed-gas underwater breathing apparatus.
AMTE(E)78401	Observations on men at pressures of up to 300 msw (31 bar).
UPS 2/78	Analysis of Submarine Escape Training. Apr 77-78.
UPS 3/78	Submarine Escape Training Tank incidents Nos 134-139.
UPS 4/78	Submarine Escape Exercise.

SHIP MOTION Working Party

Committee Papers

SMWP 2/77	Note by SP(N)
SMWP 5/77	Head movement induced by angular oscillation of the body in the pitch and roll axes (FPRC /1348).
SMWP 7/77	Incidence of motion sickness.
SMWP 9/77	Draft questionnaire on incidence of motion sickness.
SMWP 10/77	Case for an automated multi-stress induction device.
SMWP 11/77	Revised questionnaire on incidence and severity of seasickness.
SMWP 13/77	Visit to HMS APOLLO.
SMWP 15/77	Laboratory studies of the effects of motion at Santa Barbara.
SMWP 16/77	Proposals for study of drug treatment of motion sickness.

SHIP MOTION Working Party

Committee Papers

SMWP 17/77	Note of discussions with Dr Channing L Ewing, Director of the US Naval Aerospace Medical Research Laboratory, Michoud, New Orleans.
SMWP 18/77	Assistance by Professor Hammerton.
SMWP 19/77	Proposals for an adaptation study.
SMWP 2/78	Recommended limits for human tolerance to the vertical shock following a vertical vibration rig failure.
SMWP 3/78	Low frequency motion simulators.
SMWP 4/78	Motion sickness and its treatment.
SMWP 5/78	Proposals for pharmacological studies.
SMWP 7/78	Visit to the United States by the Chairman and Secretary.
SMWP 9/78	A pilot study on the incidence of seasickness in RN personnel on two ships.

Note: Reports and papers are not necessarily available to the public or to commercial organisations.

Annex C
to RNP 2/79

RELATED PUBLICATIONS in scientific journals etc

BADDELEY A D & LONGMAN D J A (1978). The influence of Length and Frequency of Training Sessions on the rate of Learning to Type. Ergonomics, 21, 627-634.

BARNARD P J & MARCEL A J (1977). A Preliminary Investigation of Factors influencing the Interpretation of Pictorial Instructions for the use of Apparatus. In: Proceedings of the Eighth International Symposium on Human Factors in Telecommunications, Cambridge, September, 379-392.

BARNARD P J, MORTON J, LONG J B & OTTLEY E A (1977). Planning menus for Display: Some effects of their structure and content on user Performance. In: Displays for Man-Machine Systems, Institute of Electrical Engineers Conference Publication, No 150, 130-133.

BARNARD P J, WRIGHT P & WILCOX P (1978). The effects of spatial constraints on the legibility of handwritten alphanumeric codes. Ergonomics, 21, 73-78.

BLOOMFIELD R J (1978). Event Timing and Recording in Digital Format for On-Line Experiments. Ergonomics, 21, 389-392.

BROWN I D (1978). Dual-Task Methods of Assessing Workload. In: Mental Work Load. Welford A T and Leplat J (Eds) Proceedings of Symposium on the 21st International Congress of Psychology, July 1976. Paris. Ergonomics, 21, 221-224.

CARLYLE R F, SHIRLEY-ANN COLLIS, GARRARD M P, HALL G J & STOCK M J (1978). Some observations on nitrogen metabolism in men during simulated dives in helium-oxygen mixtures to depths up to 420 metres of sea-water (43 bar). J. Physiol. 282, 36-37.

CARLYLE R F (1978). Some effects on urinary excretion of catecholamine metabolites in men during simulated dives of up to 30 metres in sea-water (31 bar). J. Physiol. 284, 110.

CARLYLE R F, GARRARD M P & STOCK M J (1978). Observations on some metabolite hormone levels in the blood of men during simulated saturation dives to 420 metres of sea-water, 43 bar, in helium-oxygen mixtures. J. Physiol. 285, 44.

CARLYLE R F, NICHOLS G, PACIOREK J A, ROWLES P & SPENCER N (1979). Changes in morphology and carbonic anhydrase content of red blood cells from men subjected to simulated dives. Physiol. Society Meeting March 23.

COLQUHOUN W P (1977). Simultaneous Monitoring of a Number of Auditory Sonar Outputs. In: Vigilance: Theory, Operational Performance and Physiological Correlates. Mackie R R (Ed). New York, Plenum Press.

COLQUHOUN W P, PAINE M W P H & FORT A (1978). Circadian Rhythm of Body Temperature During Prolonged Undersea Voyages. Aviation, Space and Environmental Medicine, 49, 671-678.

CRAIG A (1978). Is the Vigilance Decrement Simply a Response Adjustment Towards Probability Matching? Human Factors, 20, 441-446.

DAVIES D M & MORRIS J E W (1978). Carbon dioxide and Vitamin D effects on calcium metabolism in nuclear submariners. Undersea Biomedical Research, (In press).

DAVIES D M (1978). Some effects on man of continuous exposure to carbon monoxide, PhD Thesis, University of London.

DAVIS F M, BADDELEY A D & HANCOCK T R (1975). Diver Performance - The Effect of Cold Water. Undersea Biomedical Research, 2, 195-213.

EVANS M J, SHARP G T H & HARRISON J R (1978). Atmospheric monitoring during a trial of AYRODEV cleaning fluid for on-site cleaning of submarine motor generators. Journal of Naval Science, 4, No. 1, 46-50.

FISHER S (1977). The Microstructure of Dual Task Interaction, 3. Incompatibility and attention switching. Perception, 6, 467-477.

FLORIO J T, MORRISON J B & BUTT W S (1977). Loss of consciousness in divers. VIth International Congress in Hyperbaric Medicine, Aberdeen.

FORSTER P (1978). Attentional Selectivity: A rejoinder to Hockey. British Journal of Psychology, 69, 505-506.

FORSTER P & GRIERSON A (1978). Noise and attentional selectivity: A reproducible phenomenon? British Journal of Psychology, 69, 489-498.

GLENVILLE M & BROUGHTON R (1978). Reliability of the Stanford Sleepiness Scale compared to short duration performance tests and the Wilkinson Auditory Vigilance Task. In: Proceedings of the Symposium on "Pharmacology of the States of Alertness". 18th Annual APSS Meeting, California, Pergamon Press.

GODDEN D R (1978). Surface Training for Underwater Work - is it sometimes worse than useless? In: Progress in Underwater Science, Gamble J C and Yorks R A (Eds) Vol 3 New Series of the Report of the Underwater Association. London: Pentech Press, 205-212.

GOLDEN F St C & HERVEY G R (1977). The mechanisms of the "after-drop" following immersion hypothermia in pigs. Journal of Physiology, 272: 26-27P.

GOLDEN F St C , HERVEY G R & WHEELER J M (1977). Evidence from computer simulation for a conductive mechanism for the "after-drop" of body core temperature after immersion hypothermia. Journal of Physiology, 271: 66P.

GOLDEN F St C (1978). Physiological changes in immersion hypothermia, with special reference to factors which may be responsible for death in the early re-warming phase. PhD Thesis, University of Leeds.

GREENE K M (1977). Causes of sudden death in submarine escape training casualties. In: Arterial Air Embolism and the Syndrome of Stroke. Eds: Hallenback J M and Greenbaum L A.

HENNESSY T R & HEMPLEMAN H V (1977). An examination of the critical released gas volume concept in decompression sickness. Proc. R. Soc. London B 197, 299-313.

HENNESSY T R (1977). Converting standard air compression tables for no-stop diving from altitude or habitat. Undersea Biomed Res. 4, 39-53.

HENNESSY T R (1977). A review of safe ascent criteria used to predict standard decompression tables. Undersea Biomed Res. 4.

HENNESSY T R (1978). A comparative approach to Laplace transform immersion. J. Comp. Applied Math 4, 89-91.

HENNESSY T R (1978). On the role of counter-transport mechanics at high pressure. Medecine Subaquatique et Hyperbare 17, 122-126.

HENNESSY T R (1978). Recent advances in decompression prediction. In: Progress in Underwater Science, ed. Gamble J and Yorke R., London Pentech Press.

HENNESSY T R, GREENE K, SHIELDS T G & HEMPLEMAN H V (1978). Predictive aspects of trimix diving to 75 metres. Undersea Biomed. Res. 5.

HERBERT M (1975). Performance after heat-disturbed sleep. In: Sleep Research Vol 4. Chase M H, Stern W C and Walter P. (Eds) p.172. Los Angeles Brain Research Institute - Brain Information Service.

HERBERT M (1976) The effects of environmental factors on performance. In: Introduction to Human Engineering. Kraiss K F and Moraal J (Eds). Cologne, Germany: Verlag TUV.

HITCH G J (1978). The Role of Short-Term Working Memory in Mental Arithmetic. Cognitive Psychology, 10, 302-323.

HUNT J C R, POULTON E C & MUMFORD J C (1976). The Effects of Wind on People: new criteria based on wind tunnel experiments. Building and Environment, 11,15-28.

JOLLY E J (1977). Ambient pressure effects on atmospheric oxygen levels in patrol submarines. Journal of the Royal Naval Medical Service, 63, 101-104.

LEITCH D R (1977). Aspects of chronic hypercapnia. PhD Thesis, University of Southampton.

LONG J (1977). Division of attention between simultaneous and successive non-verbal signals varying in discriminability. Quarterly Journal of Experimental Psychology, 29, 7-30.

LONG J (1977). Division of Attention: Evidence for a between-trial component of impaired performance. Quarterly Journal of Experimental Psychology, 29, 107-116.

MAY THELMA, MACLENNAN W J & LYE M D W (1977). The effect of potassium supplements on total body potassium levels in the elderly. Age and Ageing, 6, 46.

McLEOD P D (1977). A dual task response modality effect: Support for multi-processor models of attention. Quarterly Journal of Experimental Psychology, 29. 651-667.

McLEOD P D (1978). Does Probe RT measure Central Processing Demand? Quarterly Journal of Experimental Psychology, 30, 83-89.

McKENZIE R S (1977). Changes in the indirect response of voluntary muscle in man during prolonged exposure to raised ambient pressure. Communication Phy. Soc. July 1977.

McKENZIE R S & WINSBOROUGH M M (1977). Changes in the indirect response of voluntary muscle in man during prolonged exposure to raised ambient pressure. III International Congress on Hyperbaric Medicine, Aberdeen.

McKENZIE R S (1977). Remote analysis of respiratory gases by mass spectrometry. Chemical Society at Imperial College.

McMILLAN G H G (1977). Occupational eye injuries - treatment in a nurse-based service. Occupational Health, June 1977, pp 235-240.

McMILLAN G H G (1977). Occupational eye injuries - case histories. Occupational Health, August 1977, pp 340-341.

McMILLAN G H G (1977). Prevention of eye injuries in shipyards. Occupational Safety and Health, December 1977, pp 4-6.

McMILLAN G H G (1977). Protecting eyes in shipyards. Occupational Hazards and Safety, 7: 4-6.

McMILLAN G H G (1978). A radiological follow-up study of the effects of asbestos in dockyard workers in Devonport. Journal of the Royal Naval Medical Service, Vol LXIX, No 2.

McMILLAN G H G (1978). Occupational eye injuries - the changing pattern. Journal of the Society of Occupational Medicine, 28, 39-43.

McMILLAN G H G (1978). The selection of protective measures against eye injuries. Journal of the Society of Occupational Medicine. 28: 44-50.

McMILLAN G H G (1978). Occupational injuries - data collection and processing. America OMA Journal of Occupational Medicine, in press.

McMILLAN G H G (1978). Is there a need for welders' health examinations? Journal of the Society of Occupational Medicine, in press.

McMILLAN G H G (1978). Acute effects of standardised welding on lung function. Annals of Occupational Hygiene, in press.

McMILLAN G H G (1978). Interim results of a study of the health of welders. Annals of Occupational Hygiene, in press.

MILROY R & POULTON E C (1978). Labelling Graphs for Improved Reading Speed. Ergonomics, 21, 55-61.

MORRIS J E W, BISHOP A, THOM J A & BLACKLOCK N J (1978). Dietary refined carbohydrate and urinary mineral excretion. Journal of the Royal Naval Medical Service, 64, 1978.

MORRISON J B, FLORIO J T & BUTT W S (1977). Observations following loss of consciousness under water. Annual Scientific Meeting, Undersea Medical Society, Toronto, May 1977.

MORRISON J B, FLORIO J T & BUTT W S (1977). Loss of consciousness in divers. VI. International Conference on Hyperbaric Medicine, Aberdeen, 1977.

MORRISON J B, FLORIO J T & BUTT W S (1978). Observations after loss of consciousness under water. Undersea Biomedical Res. Vol 5 No 2, June 1978.

MORTON J, CLARK I, BARNARD P J & LONG J B (1977). Components of Incompatibility in Man-Computer Interaction. In: Proceedings of the Eighth International Symposium on Human Factors in Telecommunications, Cambridge, September.

MURRELL G A (1977). Combination of Evidence in a Probabilistic Visual Search and Detection Task. Organizational Behavior and Human Performance, 18, 3-18.

MURRELL G A (1977). Combination of Evidence in Perceptual Judgement. In: Human Judgement and Decision Making in Applied Settings. Kaplan M F and Schwartz S (Eds) Academic Press: London.

OLIVER T J (1978). Vibration white finger in dockyard workers. Proceedings of the 19th International Congress on Occupational Health; in press.

PECK A W, ADAMS R, BYE C & WILKINSON R T (1976). Residual effects of hypnotic drugs: Evidence for individual differences on vigilance. Psychopharmacology, 47, 213-216.

POULTON E C (1977). Arousing Stresses increases Vigilance. In: Vigilance, Theory, Operational Performance and Physiological Correlates. Mackie R R (Ed), Plenum Press: New York, 423-459.

POULTON E C (1978). Blue Collar Stressors. In: Stress at Work. Cooper C and Payne R (Eds) London: Wiley, pp. 51-79.

POULTON E C (1977). Continuous Intense Noise masks Auditory Feedback and Inner Speech. Psychological Bulletin, 84, 977-1001.

POULTON E C (1977). Quantitative Subjective Assessments are almost always biased, sometimes completely misleading. British Journal of Psychology, 68, 409-425.

POULTON E C (1978). A New look at the Effects of Noise: A Rejoinder. Psychological Bulletin, 85, 1068-1079.

POULTON E C (1978). A New Look at the Effects of Noise upon Performance. British Journal of Psychology, 69, 435-437.

POULTON E C (1978). A Note on the Masking of Acoustic Clicks. Applied Ergonomics, 9, 103.

POULTON E C (1978). Increased vigilance with vertical vibration at 5 Hz: an alerting mechanism. Applied Ergonomics, 9, 73-76.

POULTON E C (1978). Workload and skilled performance. In: Psychology at Work, Warr P B (Ed), 2nd Edition. Harmondsworth: Penguin.

POULTON E C & EDWARDS R S (1977). Perceptual load in searching for sloping colored lines camouflaged by colored backgrounds: A Separate-Groups Investigation. Journal of Experimental Psychology: Human Perception and Performance, 3, 136-150.

POULTON E C, HUNT G M, CARPENTER A & EDWARDS R S (1978). The Performance of Junior Hospital Doctors following Reduced Sleep and Long Hours of Work. Ergonomics, 21, 279-295.

PRESTON F S, BATEMAN S C, MEICHEN F W, WILKINSON R & SHORT R V (1976). Effects of Time Zone Changes on Performance and Physiology of Airline Personnel. Aviation Space and Environmental Medicine, 47, 763-769.

SHIELDS T G (1977). Role of surfactant in the pathology of acute hyperbaric pulmonary oxygen toxicity; an electron microscopical study. Undersea Biomedical Research, 4, A19-20 (abstract).

THOM J A, MORRIS J E W, BISHOP A & BLACKLOCK N J (1978). The influence of refined carbohydrate on urinary calcium excretion. British Journal of Urology, 50, 459-464.

THOM J A & MORRIS J E W (1978). Is maritime malnutrition still with us? Journal of the Royal Naval Medical Service, 64, 69-77.

WILKINSON R T (1978). Hours of work and the twenty-four-hour cycle of rest and activity. In: Psychology at Work. Warr P B (Ed) 2nd Edition, Harmondsworth: Penguin.

WING A M & BADDELEY A D (1978). A Simple Measure of Handwriting as an index of stress. Bulletin of the Psychonomic Society, 11, 245-246.

WINSBOROUGH M M & McKENZIE R S (1977). Pulmonary oxygen toxicity and the pre-odematous lung. Médecine Aéronautique et Spatiale XVI, No 63, 254-256.

WINSBOROUGH M M & McKENZIE R S (1977). Pre-oedema in pulmonary oxygen toxicity. VI International Conference on Hyperbaric Medicine, Aberdeen 1977.

WINSBOROUGH M M (1978). Cardio-respiratory response to exercise at depth. Joint Meeting of RSM and Breathing Club: International Colloquium on $\dot{V}_A/\dot{Q}c$, London, 1978.

WRIGHT P (1978). Behavioural research and the technical communicator. Technical Communication, 25, 6-12.

WRIGHT P (1977). Behavioural Research and the Technical Communicator. The Communicator of Scientific and Technical Information, 32, 3-13.